

Future Challenges Facing SEE Pulsed Laser Technique

Stephen Buchner,
QSS Group Inc/NASA GSFC
Dale McMorrow,
Naval Research Laboratory

To be presented by Stephen Buchner at the 2006 Single Event Effects Symposium (SEESYM), April 10, 2006 to April 12, 2006 in Long Beach, CA.

1

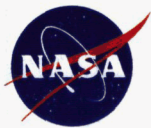


What is the Basis of the Pulsed Laser Technique?

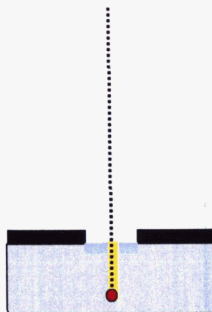
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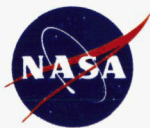


Charge Generation by Ion Beam

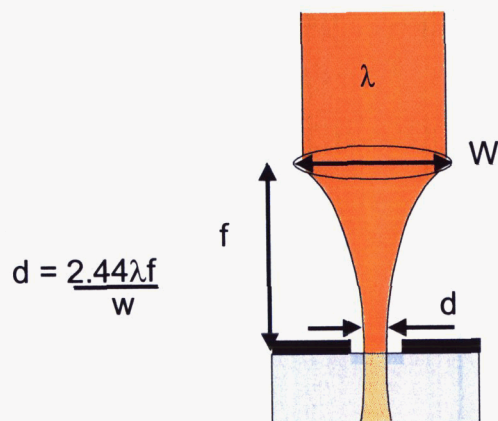


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Charge Generation by Pulsed Focused Laser Beam



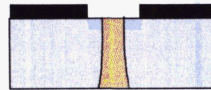
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Charge Generation by Pulsed Focused Laser Beam



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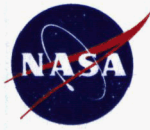


What are the Challenges?

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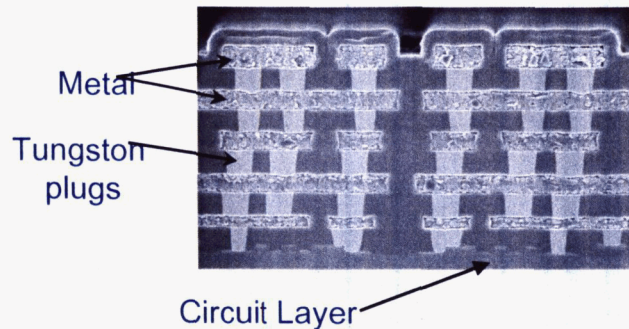
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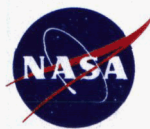
Future Challenges

- **Metallization**



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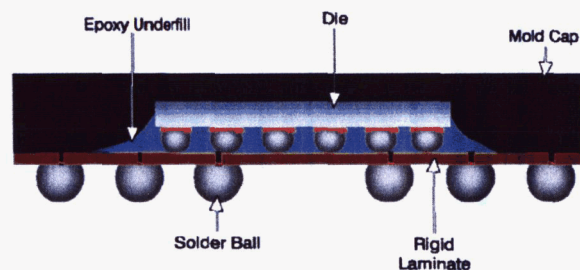
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Future Challenges

- Metallization

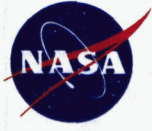
- **Packaging**



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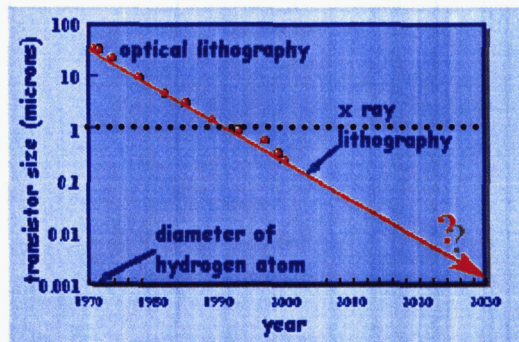
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Future Challenges

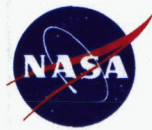


- Metallization
- Packaging
- **Scaling**



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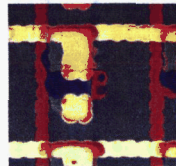
Future Challenges



- Metallization
- Packaging
- Scaling

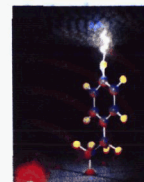
- **Exotic Materials**

Plastic Transistor



Carbon Nanotubes

Magnetic Memory

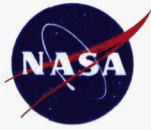


Single Molecule Transistor

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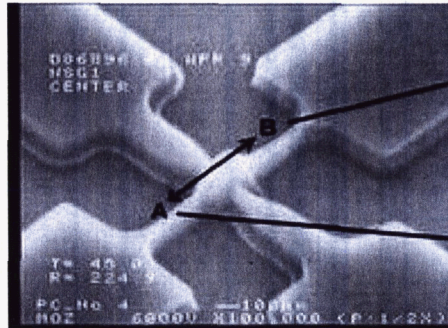
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Future Challenges

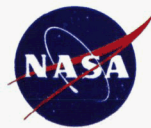


- Metallization
- Packaging
- Scaling
- Exotic Materials
- **Novel Structures**



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Future Challenges



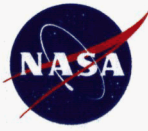
- Metallization
- Packaging
- Scaling
- Exotic Materials
- **Novel Structures**

- **Equipment** \$\$\$\$\$\$ and cumbersome

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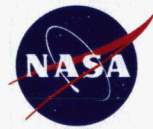
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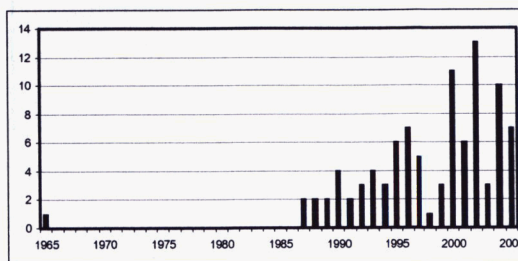
Current State of Technique

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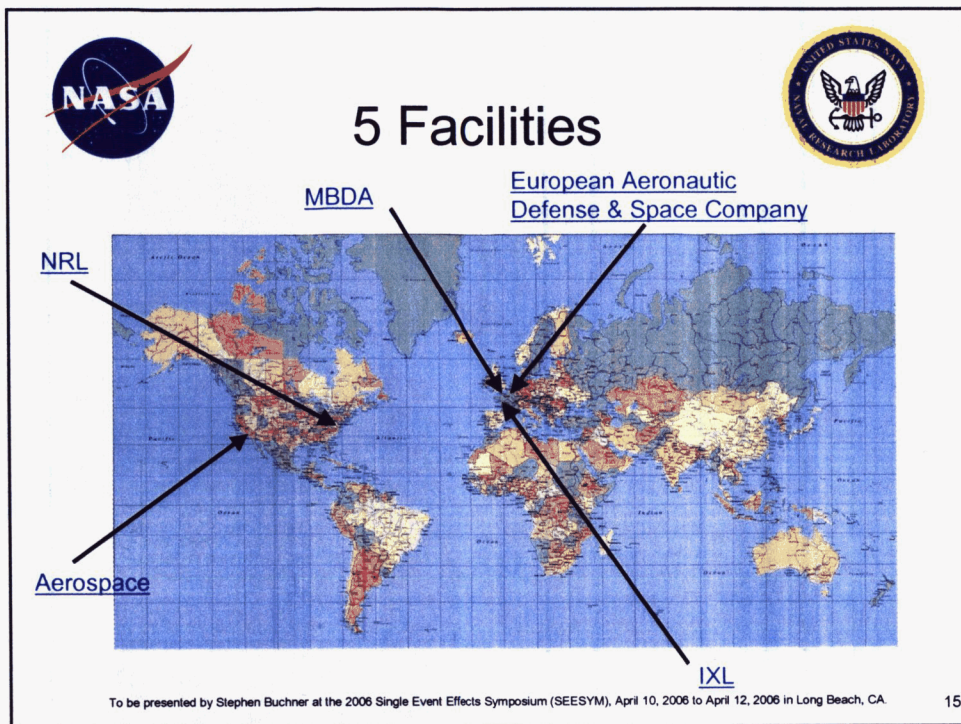
~100 Papers



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The slide features the NASA logo in the top left and the United States Air Force Research Laboratory logo in the top right. The title "Pulsed Laser Can Produce ..." is centered at the top. Below the title is a bulleted list of four items: Single Event Transient (SET), Single Event Upset (SEU), Single Event Latchup (SEL), and Single Event Snapback (SES). The text is in blue. At the bottom, there is a line of small text indicating the presentation details and a page number "16".

Pulsed Laser Can Produce ...

- **Single Event Transient (SET)**
- **Single Event Upset (SEU)**
- **Single Event Latchup (SEL)**
- **Single Event Snapback (SES)**

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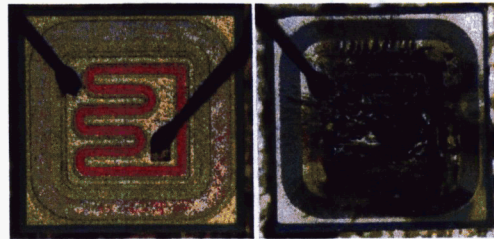
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Pulsed Laser Cannot Produce....

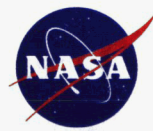


- **Single Event Gate Rupture**
- **Single Event Burnout due to metal**

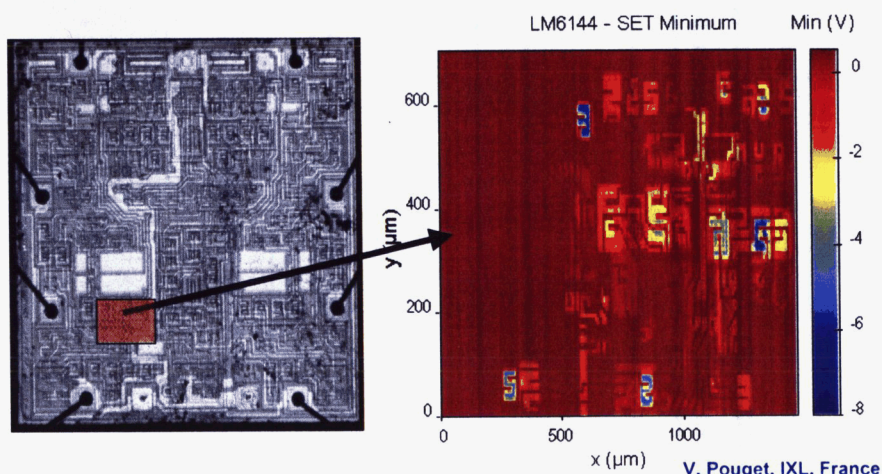


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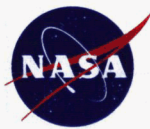
Spatial Information



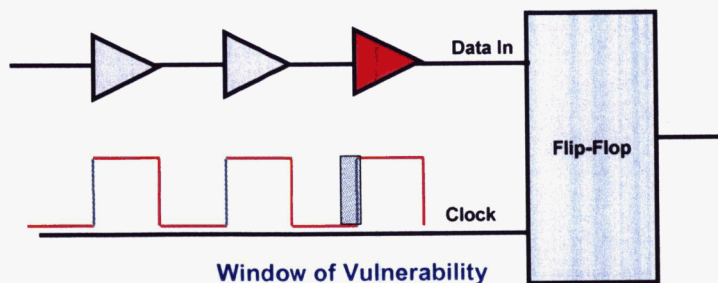
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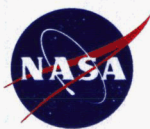


Temporal Information



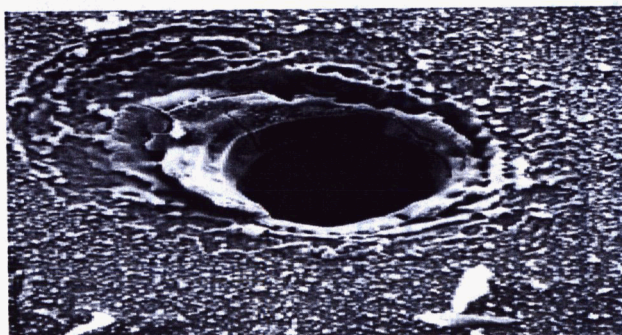
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Very High LET

LET \gg 100 MeV.cm²/mg
Limited by material damage



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Caveats

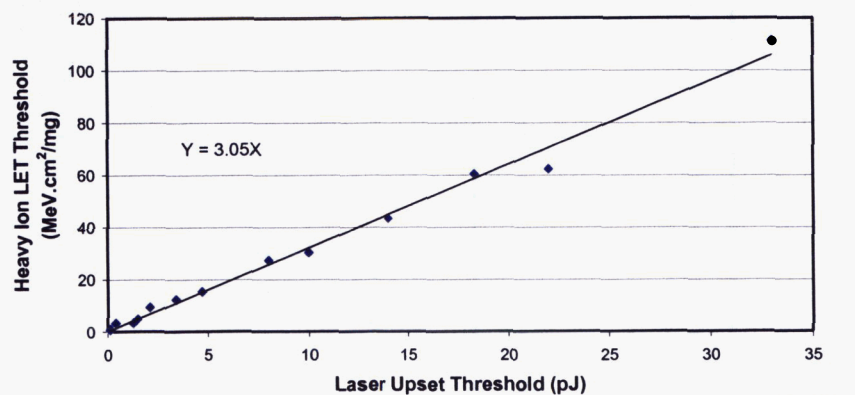


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Ion LET Threshold from Laser Energy Threshold

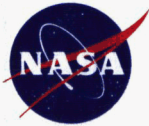


McMorrow IEEE TNS 2000

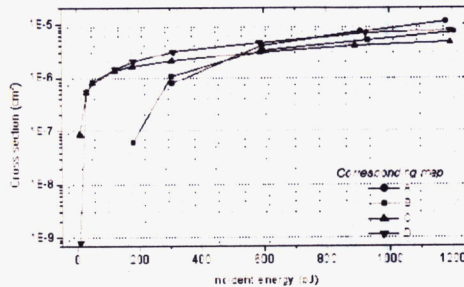
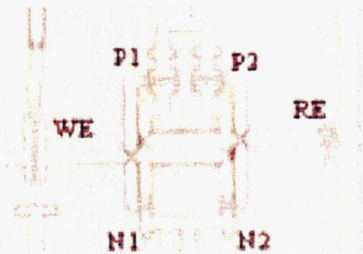
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Cross-Section



- No metal.
- Large structures.

V. Pouget, IXL, France

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Cross-Section

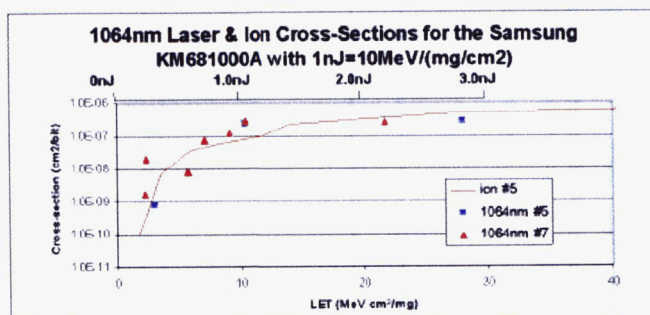


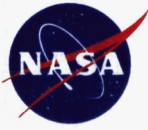
Figure 2.15. Calibration of the infrared results against the ion cross section for the Samsung KM681000A

Chugg et al. ESCIES Report

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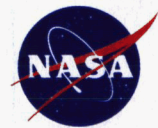


The Future...



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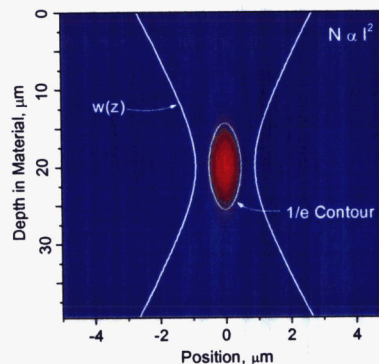
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Two Photon Absorption (TPA)



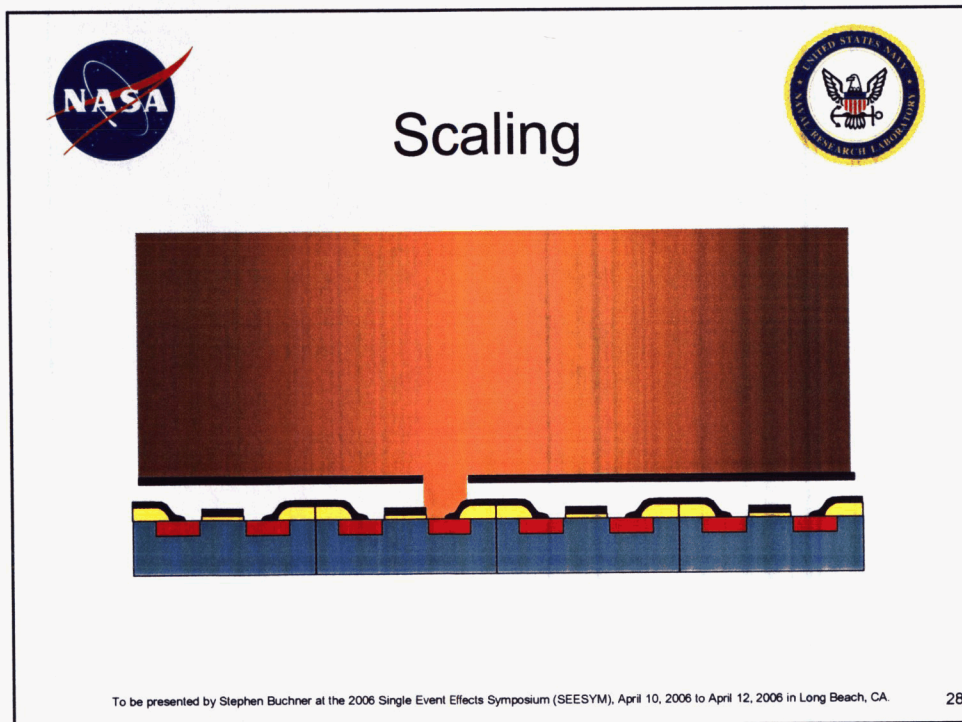
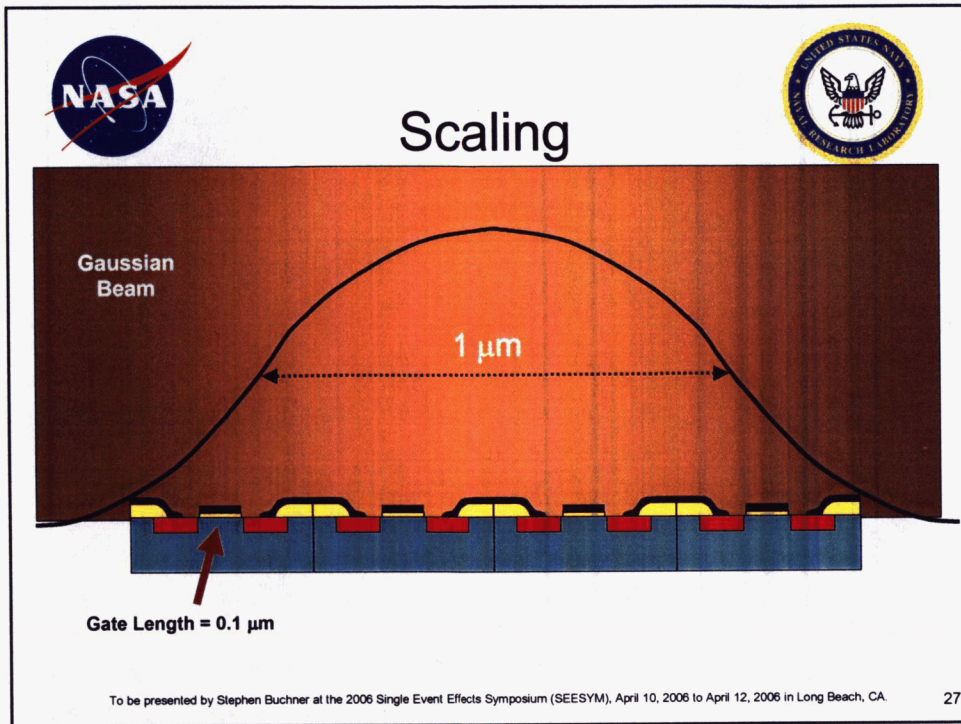
TPA avoids the problems associated with metal on the top surface and with flip-chip packaging by having the light incident from the backside.



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New Materials

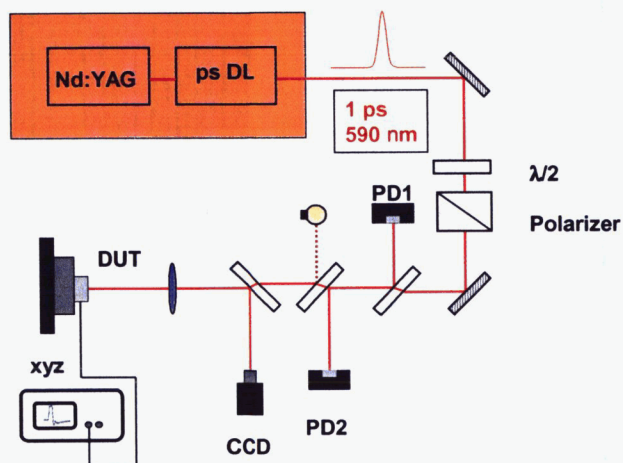
- Adjust the wavelength to ensure absorption

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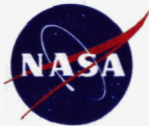
Equipment



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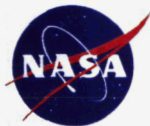
New Laser Source

- < 100 ps pulse width
- Single shot to 100 MHz
- Pulse Energy = 8 pJ
- Multiple wavelengths



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Summary

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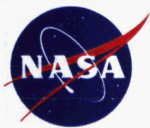
Try it, you'll like it!



Life Cereal Ad 1972 - 1987

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Summary

- **Challenges for the pulsed laser:**
 - Metal
 - Package
 - Scaling
 - Exotic materials
 - Novel devices
 - Equipment
- **One has to be innovative to handle the challenges**

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